

*Knitting the Periodic Table*

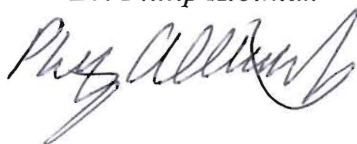
**An Honors Thesis (HONRS 499)**

**by**

*Lauren Denise Bannister*

**Thesis Advisor**

*Dr. Philip Albinia*

A handwritten signature in dark ink, appearing to read "Philip Albinia", written in a cursive style.

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Muncie, Indiana**

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## Abstract

Knitting and chemistry are not two things that most people would group together. Often the arts and science are viewed as two separate entities that have rare occasion to exist together in harmony. Contrarily, it seems as though science and creativity should go hand in hand – where there are great creative efforts put towards science, new things can be discovered and old problems can be solved. In order to illustrate the importance of this relationship between science and creativity, I mesh the art of knitting together with one of the most fundamental and useful scientific tools that exists – the periodic table of the elements.

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## Acknowledgements

I would like to thank Dr. Philip Albiniak for agreeing to be my advisor throughout this long process. His trust and patience has been enormously appreciated.

I would also like to thank Laura and my mother and father for offering me their support in any way they could possibly think to offer it while I was so busy with this project.

## Author's Statement

I love to knit, and I love chemistry; what better way to marry those two than to knit the periodic table? This process was filled with great amounts of decision making, some decisions large and some of them small, but all of them equally important to the overall look and feel of the finished product.

Knitting a blanket is no small feat. As an overview, I will list the general process that I went through. I began by formulating a plan for the design of the blanket. Second, I determined how big each square would be and from that information extrapolated how large the overall blanket would be. Third, I picked a brand and type of yarn for the knitted portion of the blanket. Fourth, I began knitting the squares that would comprise the blanket. Fifth, I sewed all the squares together. Sixth, I added the symbols for each element. Finally, I added a fabric backing to the knitted portion of the blanket.

The first thing I did was draw up a design for my blanket. This consisted of drawing up a grid of squares by making a table in Microsoft Word and filling in the squares with the various elements of the periodic table and where they would be located in the blanket (Figure 1). Originally I had planned a table that was 18 squares long and 13 squares wide. My finished product ended up being 18 squares long as originally planned but only 10 squares wide. This gave a finished product with a total of 180 squares. The entire periodic table fits onto the blanket with the bottom two rows being the lanthanides and actinides as traditionally removed from the periodic table. These elements are traditionally removed from the middle of the table and shown at the bottom in order to make the table a more manageable and concise tool to use and present. I saw no reason to alter the traditional design of the periodic table and therefore presented its shape accurately when planning my blanket.

**Figure 1.**

18 x 6 = 108 = 7' 6" long  
12 x 6 = 72 = 5' 5" wide  
18 x 12 = 216 squares

brown 17 blocks  
different shade or color?

The second step in the process of knitting my blanket was to determine the size of each individual square. It was important to keep in mind that the size of each square has a huge impact on the size of the blanket as a whole because there were such a large number of squares to be used. I chose to make my squares five inches on each side. By making several paper squares, I determined that this size would be large enough to adequately display the chemical symbol of the elements while still maintaining a reasonable overall blanket size. With five-inch squares, the finished dimensions of the knitted portion of the blanket were estimated to be 50 inches by 90 inches (roughly four feet by seven feet). This is a size equivalent to a comforter that would go on a twin-sized bed.

The third step in the process was picking the yarn I would use to knit the squares. I looked at yarns for a while trying to decide which one I wanted to use. I narrowed down my choices to acrylic or an acrylic/wool blend. I made this selective elimination because the colors of the blanket were very important. I wanted to choose a fiber blend that would help the colors stay bright and not fade over time. This is easily accomplished by using an acrylic yarn. I finally decided to get I Love This Yarn! brand yarn. It is a 100% acrylic fiber yarn. The price is reasonable at approximately 4 dollars per ball of yarn and they also have an amazing selection of colors. I had no problem picking out the colors I would use for the squares. The colors were picked arbitrarily as they have no real meaning or connection to the elements themselves. The main importance of the color was to indicate a separation between various types of elements. Each type of element on the blanket is a different color. The elements can be divided into types based on various criteria, so some representations of the periodic table may have different groupings of elements than does my table. However, the groups I chose to separate my elements into were the alkali metals, the alkaline earth metals, the transition metals, the poor metals, the noble gases, the other non-metals, the lanthanides, and the actinides. The groups were designated the following colors: orange, yellow, dark pink, teal, green, light blue, light pink, and purple, respectively.

The next step of the process and the part that required the most attention was the actual knitting of the squares. Knitting is made up of two types of stitches – a knit stitch and a purl stitch. With the knowledge of these two stitches anything can be created. The stitches are made by looping yarn around a pencil shaped object called a knitting needle, and using a second needle to take a working strand of yarn and pull it through the loops on the first needle, creating an interwoven pattern of loops that when finished is a whole knitted object. The difference between a knit and a purl stitch is simply the direction in which the working strand of yarn is pulled through the loops on the first needle. I knit my squares in a pattern called “stockinette stitch.” This simply refers to the times I chose to knit and the times I chose to purl. By knitting one row and then purling the next, I create a uniform fabric that consists of entirely v-shaped knit stitches on one side and bar-shaped purl stitches on the “back” side (Figure 2).



**Figure 2. An example of the v-shaped knit stitches.**



In order to make the squares the correct size (five inches), several variables had to be considered. Three main things are involved in the size of a stitch. The first is the needles used. Every knitting needle has a certain circumference. Using a larger needle results in a larger stitch, while using a smaller needle results in a smaller stitch. The second is the yarn being used. Each yarn has what is called a certain “ply,” which is the number of strands of fiber that make up the total strand. I used both an average size needle (size 6) and an average-ply yarn (medium weight). The third thing that accounts for stitch size is the tension in the working strand of yarn. By holding the yarn more tightly, more tension is held in the strand creating a smaller, tighter stitch. All of these things combined together create a knitter’s individual “gauge.” By knitting a few sample squares, I was able to determine the number of stitches it would take me to knit a five by five square. Each knitter’s gauge is different. However, my final number of stitches used was 20 stitches per row. I knitted a total of 25 rows and this provided me with a five by five inch square.

There were a total of 180 squares to knit. Each group had a different number of colored squares as follows:

Alkali metals: 6 squares  
Alkaline earth metals: 6 squares  
Transition metals: 34 squares  
Poor metals: 18 squares  
Noble gases: 7 squares  
Other non-metals: 15 squares  
Lanthanides: 15 squares  
Actinides: 15 squares  
Hydrogen: 1 square

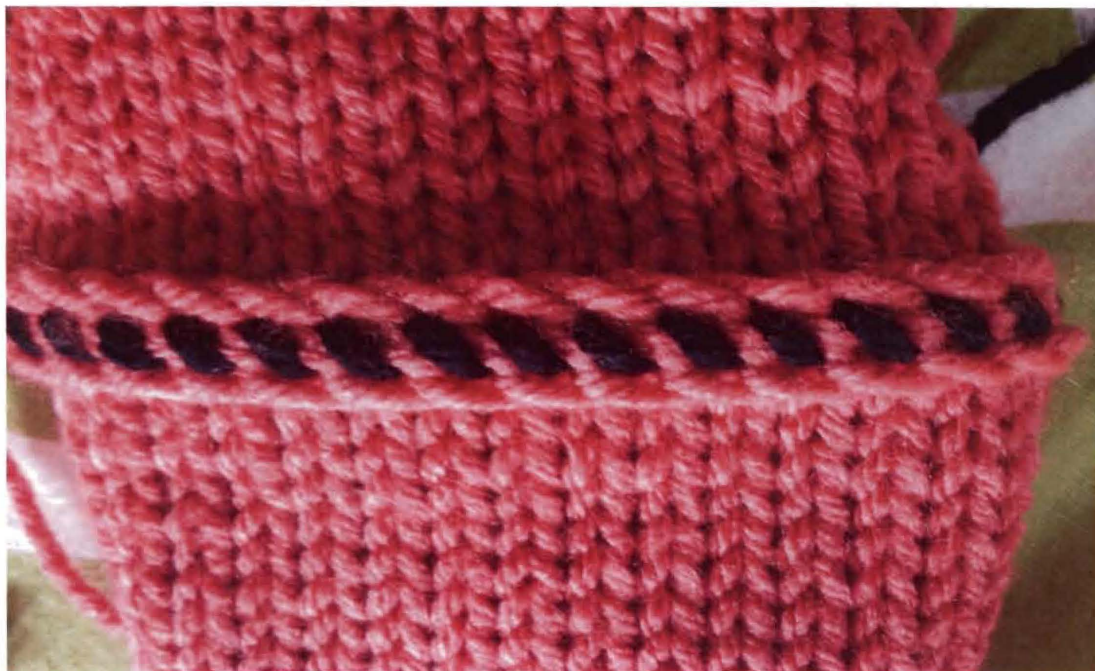
The remaining squares were plain white squares placed in order to fill up the empty spaces around the various groups of elements. By timing myself while knitting a square, I determined that each square took approximately 25 minutes to knit. For a total of 180 squares, this was a grand total of 75 hours' worth of knitting in order to complete all of the squares.

Once all the squares were knitted, my next task was to sew them all together in the established pattern. When knitting, I left approximately ten inches of yarn on each end of the square in order to use for sewing the squares together. Ultimately, however, I chose to use strands of black yarn to sew the squares together so that the various elements would be more clearly delineated. On the white squares I was able to use the attached tail yarn to sew the squares together since the white squares were just filler making up one cohesive part of the blanket that required no delineation of individual squares.

I sewed the squares together by placing two squares together, one on top of the other, with the wrong sides facing each other. I then inserted a threaded needle through one square and into the next, repeating this over and over along the length of the five-inch square (Figure 3). I did this for each side of the square. I sewed each group of elements together separately and then joined them together with the other groups of elements (Figure 4). The final parts I sewed were the white filler pieces (Figure 5). After attaching these pieces, the entire knitted portion of the blanket was completed (Figure 6).



**Figure 3.**



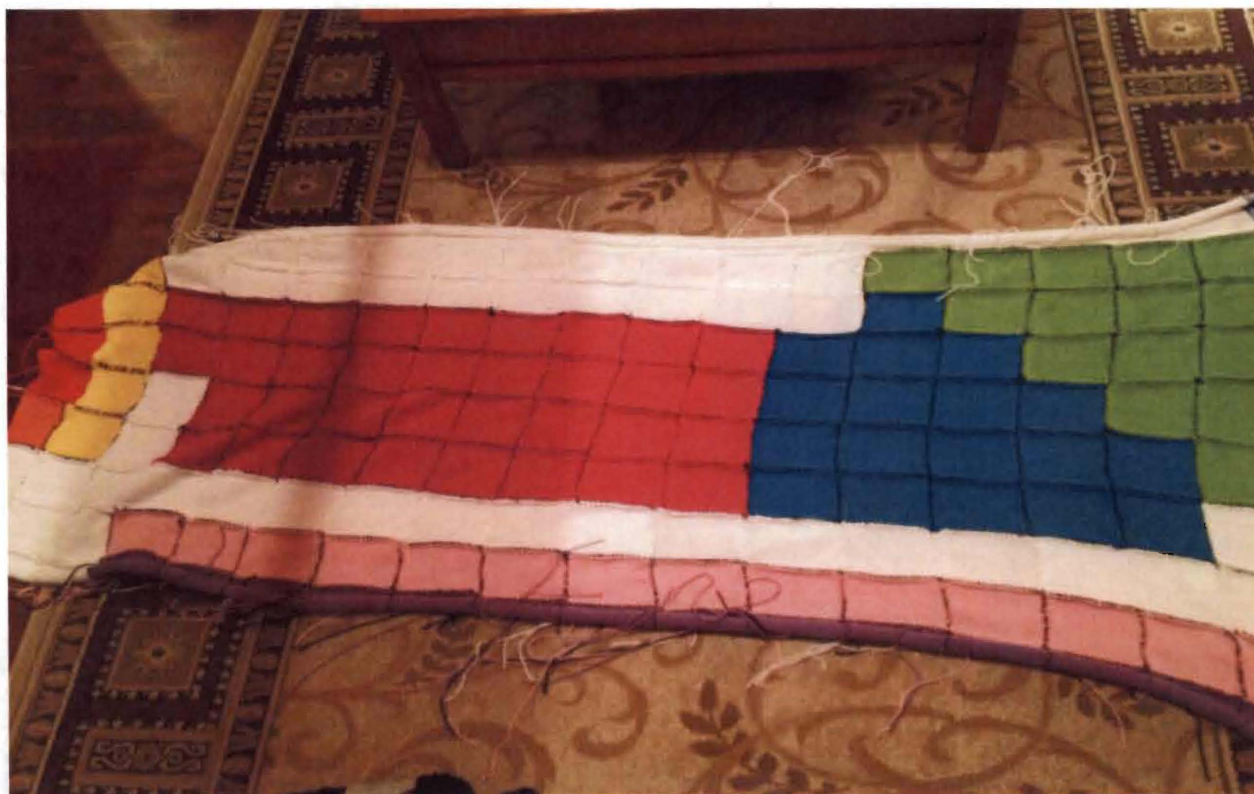
**Figure 4.**



**Figure 5.**



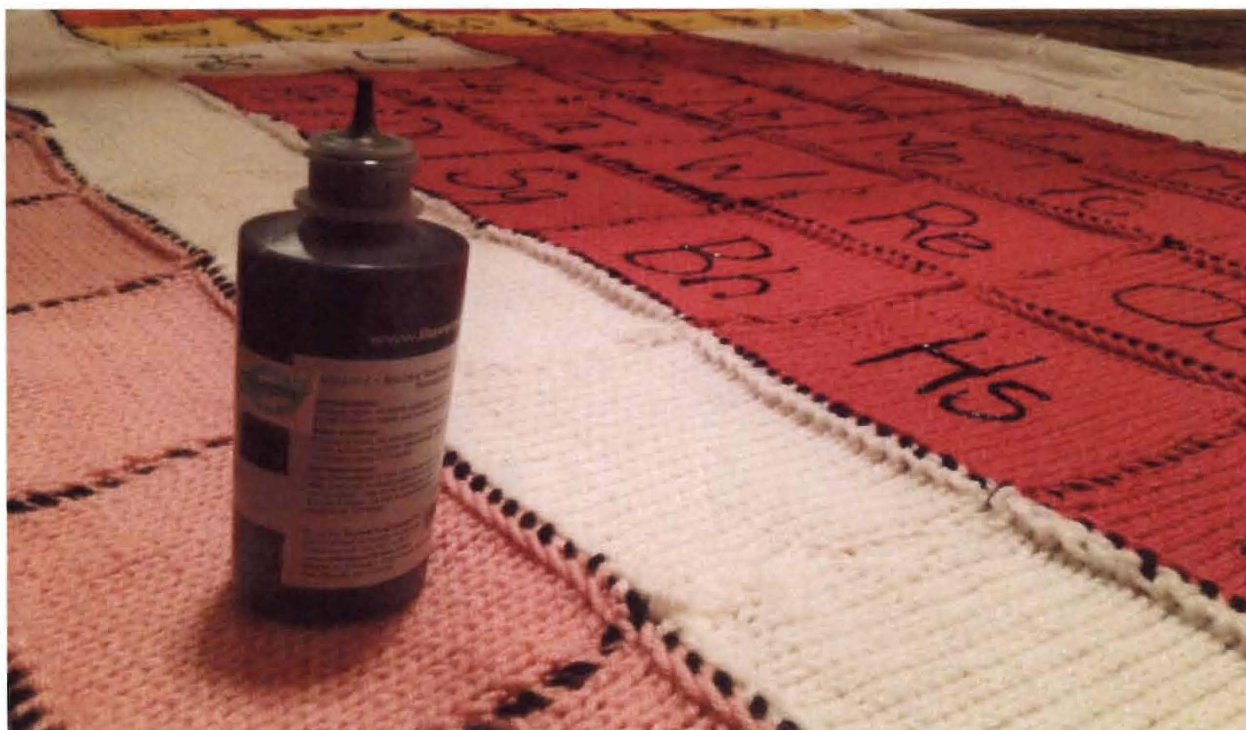
**Figure 6.**





Once the entire blanket was whole, the next step was to put the symbols onto the squares. I chose to do this with fabric paint so that I would have the most control over how the symbols were written. I used black for all the symbols in order to allow for maximum clarity in reading the symbols as the majority of the colors were light or pale colors (Figure 7). A tendency of stockinette stitch is that it tends to roll up on the edges. This happens because the knit stitches on the front side of the fabric are shorter than the purl stitches on the back side of the fabric, causing the fabric to pull in on itself. In the middle of the blanket, this problem was eliminated by sewing the squares together. However, on the outsides of the blanket this was still a problem. Therefore, in order to write the symbols onto the blanket, the entire blanket was taped to the floor along the edges in order to keep it from rolling while the fabric paint was applied and while it was drying.

**Figure 7.**



After the fabric paint had dried, the final steps in finishing the blanket were carried out. The major final step was to find a solution to the problem of the blanket curling up on the edges. The solution I chose was to sew a fabric backing onto the blanket (Figure 8). To begin with, I turned the blanket over so that it was wrong-side up and tied the tail ends of each square together to eliminate holes at the junction of any four squares. I then trimmed the excess yarn from each tail piece. The piece of fabric I chose needed to measure a few inches bigger on each side than the actual blanket because of the tendency of knitting to stretch. My piece of fabric was measured to be 54 inches wide and 94 inches long. I placed the piece of fabric right side up on the floor, and then placed the blanket right side down on top of the fabric. I then went around the edges of the blanket and pinned the fabric to the knitted portion. Following pinning, I used a sewing machine to attach the knitted portion to the fabric. I kept the sewing machine on the floor even though sewing machines are meant to be used at tables. I didn't want the blanket's weight

and stretch to affect the stitching of the sewing machine. I sewed around the entire perimeter of the blanket except for a section about 10 inches wide. This section was left unsewn so that the blanket could be turned right-side out through the opening. Once the blanket was right-side out, I hand sewed the remaining opening using invisible stitching to match the rest of the invisible seam already sewn.

**Figure 8.**



After the fabric portion of the blanket was sewn on, the blanket was complete with final dimensions of 50 inches by 90 inches (Figure 9). I believe it's important that I was able to learn enough over my four years of college such that I was able to blend my creative side with my scientific side. I know this practice will benefit me later in life because I believe that science is truly about being creative in order to advance and learn. I completed this project so that others can know and see that it is possible to blend two beloved things even if they don't seem to go well together on first glance.



Figure 9.

